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APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

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1. ☒ Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)
2. ☒ Specification [Total Pages / 54 /]
(preferred arrangement set forth below)
 - Descriptive title of the Invention
 - Cross References to Related Applications
 - Statement Regarding Fed sponsored R&D
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings (if filed)
 - Detailed Description
 - Claim(s)
 - Abstract of the Disclosure
- ☒ Drawing(s) (35 USC 113) [Total Sheets / 4 /]
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Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
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5 **Interface Class Discovery Method and Device**

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to an earlier
filed U.S. provisional patent application having Serial
10 No. 60/139,112, which was filed on June 14, 1999. This
provisional patent application is hereby incorporated by
this reference into this disclosure.

BACKGROUND OF THE INVENTION

15 1. FIELD OF THE INVENTION

The present invention relates to a device and
method of discovering the type of telephone switch being
used in a telephone system.

20 2. DESCRIPTION OF THE PRIOR ART

It is known in the prior art to determine the
interface class of a telephony network by reading
reference material corresponding to a device connected
to the network. For example, a model number of a
25 telephone is discovered by looking at the telephone, and
then an owner's manual corresponding to the telephone is
referenced. If the owner's manual lists the interface
class used by the telephone, one can assume the

interface class of the telephone is the interface class
for the network. Alternatively, the vendor of the
telephone may be contacted and asked to provide the
interface class. These current methods of determining
5 the interface class of a communication pathway, such as
a telephony network, are time consuming.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a
10 method and device for determining the interface class of
a communication pathway.

Accordingly, the present invention includes a
method of providing an indication signal. First, a
communication pathway carrying signals is provided, and
15 an interface device is connected to the communication
pathway. The interface device has conductors for
carrying the signals provided by the communication
pathway. Next, the signals carried by the conductors
are analyzed to determine which of the conductors are
20 active conductors. Then information about the active
conductors or information about the signals carried by
the active conductors is compared to information
corresponding to a known interface class. If the active
conductor information is similar to the interface class
25 information, then a first type of indication signal is

sent to indicate the similarity. However, if the active conductor information is not similar to the interface class information, then a second type of indication signal is sent to indicate the lack of similarity.

5 The present invention also includes devices for executing the method. One such device has a switch interface device connected to a computer, having software running thereon. Another device is a computer readable storage medium having encoded instructions
10 capable of instructing a computer to execute the method of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows steps of a method according to the
15 present invention;

Figure 2 shows steps of another method according to the present invention;

Figure 3 shows devices according to the present invention; and

20 Figure 4 shows more detail of conductor selection device shown in Figure 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Figures 1 and 2 illustrate a method according to
25 the present invention. The depicted method results in

providing an indication signal. In one embodiment of the present invention, the indication signal is a first type if a possible interface class has been discovered, and is a second type if an interface class has been
5 considered and found not to be a possible interface class. In the method, a communication pathway is provided and connected to an interface device having conductors (step 10). The communication pathway carries signals, and the conductors are capable of carrying the
10 signals. In a telephony network, the conductors are commonly referred to as "pins."

Next, the signals carried by the conductors are analyzed to determine which of the conductors are active conductors (step 13), and active conductor information
15 is provided (step 16). For example, the active conductor information may include a list of the active conductors. In a preferred embodiment of the method, the signals analyzed are restricted, for example by using an attenuator, to a desired voltage range. In one
20 embodiment of the invention, the voltage range is restricted to between +5 volts and -5 volts.

In the method, interface class information is provided (step 19) and compared to the list of active conductor information. The interface class information
25 preferably includes information about the active

conductors for a known interface class. Then, a determination is made as to whether the interface class information is similar to the active conductor information (step 22). If the interface class information is determined to be similar to the active conductor information, then the first type of indication signal is provided (step 25). Alternatively, if the interface class information is determined not to be similar to the active conductor information, then the second type of indication signal is provided (step 25).

Analyzing the conductors to determine which of the conductors are active conductors (step 13) preferably includes selecting a conductor and analyzing the signal carried by the selected conductor to determine whether a voltage of the signal alternates. If the voltage of the signal carried by the selected conductor alternates, then the selected conductor may be considered a possible active conductor. Further analysis of the signal carried by a possible active conductor may be required to confirm a possible active conductor is in fact an active conductor.

The information about the active conductors for a known interface class may be considered to be similar to the active conductor information (step 22) if the information about the active conductors for the known

interface class is among the active conductor
information. For example, if it is determined
conductors 1 through 6 are active, and a first interface
class uses conductors 1 through 4 while a second
5 interface class uses conductors 3 through 6, then both
the first and second interface classes might be
considered possible interface classes. In the example,
further analysis of the signals carried by conductors 1
through 6 would be necessary to determine which
10 interface class is the interface class used on the
communication pathway. However, if a third interface
class used conductor 7 or conductor 8, then the third
interface class could be excluded from the possible
interface classes that could be in use on the
15 communication pathway.

It may be beneficial to determine which conductors
are active conductors (step 13) by excluding inactive
conductors from consideration. To do so, a preferred
embodiment of the present invention determines which
20 conductors carry a signal having an alternating voltage,
and then determines an average amplitude voltage value
for each of those conductors. Next, a reference
amplitude voltage is determined, and a determination is
made as to which of those conductors carrying an
25 alternating voltage have an average amplitude voltage

value less than the reference amplitude voltage. The reference amplitude voltage value may be determined by selecting the highest average amplitude voltage value of all conductors, and setting the reference amplitude
5 voltage to some fraction of the highest average amplitude voltage value. For example, the fraction may be one-half.

In this embodiment of the method, determining the average amplitude voltage value for one of the
10 conductors carrying a signal having an alternating voltage may include measuring the voltage amplitude of the signal carried by one of the conductors during a first period of time and during a second period of time. Then the maximum measured voltage amplitude during the
15 first period of time is selected, and the maximum measured voltage amplitude during the second period of time is selected. The average of the selected maximum measured voltage amplitudes is determined to be the average amplitude voltage value.

20 Measuring the voltage amplitudes during the first and second periods of time is preferably done at a plurality of discrete times during each time period. The plurality of measurements corresponding to the plurality of discrete times during a time period can be
25 considered an array of measurements for the time period.

Figure 2 shows a method according to the present invention, wherein the grouping (sometimes referred to as "pairing") of conductors (step 28) may be determined by analyzing the signals carried by the conductors to determine which of the conductors are active conductors, and then grouping the active conductors into groups of active conductors. For example, in a telephony system,

25 active conductors. For example, in a telephony system,

known interface classes pair the conductors, and so the groups of active conductors will each have two active conductors.

Then, primary interface class information,
5 including information about the pairing of conductors for a known interface class, is provided (step 19) and compared (step 34) to the information about the groups of active conductors. If the pairing of conductors for the known interface class is similar to the group
10 information, then a first type of a first indication signal is provided to indicate the known interface class is similar to the interface class used on the communication pathway. Alternatively, if the pairing of conductors for the known interface class is not similar
15 to the group information, then a second type of the first indication signal is provided to indicate the known interface class is not similar to the interface class used on the communication pathway.

Grouping the active conductors (step 28) may be
20 done by determining possible pairs of active conductors, and determining an auto correlation value corresponding to each possible pair of active conductors (the "pair auto correlation value"). As used herein, the term "auto correlation" refers to manipulation of data
25 primarily corresponding to a single conductor. A

threshold value is set and compared to the pair auto correlation value. Those possible pairs of active conductors having a pair auto correlation value below the threshold value are eliminated from further
5 consideration.

The pair auto correlation value corresponding to a possible pair of active conductors may be determined by measuring a voltage amplitude of the signal carried by a first one of the active conductors at a plurality of
10 discrete times during a first time period to provide a first array of voltage amplitudes. Next, each of the voltage amplitudes in the first array is squared. Then the squared voltage amplitudes are added together to provide a first sum of squares value. A second sum of
15 squares value is determined for the first active conductor corresponding to a second time period in a manner similar to that used to provide the first sum of squares value. Next, third and fourth sum of squares values are determined for the second conductor
20 corresponding to the first and second time periods in a manner similar to that used for the first and second sum of squares values respectively.

Then, a first auto correlation value is determined by adding the first sum of squares value to the second
25 sum of squares value. Similarly, a second auto

correlation value is determined by adding the third sum of squares value to the fourth sum of squares value. The auto correlation value corresponding to the possible pair of active conductors is the average of the first
5 auto correlation value and the second auto correlation value.

After determining a pair auto correlation value for each possible pair of active conductors, the threshold value may be set equal to a multiple of the lowest pair
10 auto correlation value. For example, the threshold value may be set at four times the lowest pair auto correlation value.

Another method for grouping the active conductors, that may be used in lieu of or in addition to that
15 described above, utilizes a cross correlation value. As used herein, the term "cross correlation" refers to manipulation of data primarily corresponding to at least two conductors. In this method, a first active conductor and a second active conductor are selected to
20 provide a possible pair of active conductors for analysis. A cross correlation value corresponding to the possible pair of active conductors (the "pair cross correlation value") is determined and compared to a threshold value. If the cross correlation value is less

than the threshold value, the possible pair of active conductors is eliminated from further consideration.

In this method, a preferred threshold value is set equal to a fraction, for example one-half, of an auto correlation value corresponding to the possible pair of active conductors. The auto correlation value may be determined as described above.

The cross correlation value corresponding to a possible pair of active conductors may be determined by using the arrays of measurements used to determine the pair auto correlation values. Each measured voltage amplitude for one of the active conductors is multiplied by the corresponding measured voltage amplitude of the other conductor. It should be noted that measured voltage amplitudes multiplied together to arrive at the cross correlation value preferably are taken at about the same discrete time, i.e. "corresponding" measured voltage amplitudes referenced in the immediately prior sentence are those measured voltage amplitudes taken at the same discrete time. The multiplied measured voltage amplitudes are summed together to provide the cross correlation value corresponding to the possible pair of conductors.

After determining the groups of active conductors and comparing the groups to information corresponding to

a known interface class, a determination is made as to whether the information corresponding to the known interface class is similar to the groups of active conductors (step 22). A preferred criteria for making
5 this determination is to deem an interface class similar if each pair of conductors in the interface class is the same as a pair of conductors in a group.

For example, it may be determined the groups of active conductors on the communication pathway include a
10 group comprised of conductors 1 and 3. If a first interface class pairs conductors 1 and 3 while a second interface class pairs conductors 1 and 4, then the first interface class is a candidate for being the interface class used on the communication pathway, but the second
15 interface class is not.

After grouping the active conductors, and comparing the groups to known interface classes, more than one known interface class may be a candidate for the interface class used on the communication pathway. One
20 method for determining which known interface class is the interface class used, involves analyzing the signals carried by the groups of conductors.

Interface classes of different encoding schemes may have different fourth moments. So, comparing the fourth
25 moment of a known interface class to the fourth moment

of a signal carried by the communication pathway can assist in determining which interface class corresponds to the signals carried by the communication pathway.

For example, the fourth moment of the group signal
5 may be compared to information about the fourth moment
of a signal carried by a corresponding pair of
conductors of a known interface class. If the
comparison results in a determination that the fourth
moments are similar, then the interface class is
10 selected as a possible interface class. Similarly, if
the comparison results in a determination that the
fourth moments are not similar, then the interface class
is eliminated as a possible interface class.
Preferably, similarity between the fourth moments is
15 present if the fourth moment of the signal corresponding
to the known interface class is within about 35% of the
fourth moment of the group signal. If similarity
between fourth moments is found, a first type of
indication signal is provided, and if similarity between
20 fourth moments is not found, a second type of indication
signal is provided.

The fourth moment measures the relative peakedness
or flatness of a distribution. The fourth moment for an
array of voltage amplitudes is determined by determining
25 the average voltage amplitude and the standard deviation

of the voltage amplitudes. Next, the difference between each voltage amplitude measurement and the average amplitude is determined and divided by the standard deviation to produce a dividend corresponding to each measured voltage amplitude. Each dividend is then raised to the fourth power (hence the term "fourth moment") to provide a result corresponding to each measured voltage amplitude. The average of the results is the "fourth moment" referred to herein.

10 After comparing the groups of active conductors to information about all known interface classes, as described above, more than one known interface class may be similar, and further analysis may be needed to determine which known interface class is the most
15 probable interface class being used on the communication pathway. One method of determining which known interface class is the most probable interface class is to analyze the spectral density corresponding to the signals sent via the communication pathway, and compare
20 that spectral density to the spectral density of known interface classes. If the spectral densities are similar, then a first type of indication signal is provided, and if the spectral densities are not similar, then a second type of indication signal is provided.

It is known that the spectral density is dependent on the bit rate and encoding scheme used. Therefore, analyzing and comparing spectral densities may enable one to differentiate between possible interface classes
5 used on the communication pathway.

One means of analyzing the spectral density is to use fast fourier transforms. A fast fourier transform is determined for each group signal (the "group FFT"), and information corresponding to each determined fast
10 fourier transform (the "group FFT information") is compared to fast fourier transform information corresponding to signals carried by pairs of conductors for known interface classes (the "IC FFT information"). The group FFT information and the IC FFT information may
15 be comprised of data points generated by the respective fast fourier transforms wherein frequency is the independent variable and voltage amplitude is the dependent variable. For example, these data points may be the product of the real and imaginary components of
20 the fast fourier transform.

In one method, the group FFT information is normalized so the maximum data point of the group FFT information for one of the time periods is the same as the maximum data point of the IC FFT information. Then,
25 a comparison is made between the normalized group FFT

information and the IC FFT information to determine the
similarity between the two sets of FFT information. The
interface class resulting in the greatest similarity is
selected as the most probable interface class being used
5 on the communication pathway.

As an example, the similarity may be determined by
subtracting the data points corresponding to the group
FFT information from the corresponding data points for
the IC FFT information to provide differential data
10 points. In this context, the word "corresponding" in
the immediately preceding sentence may refer, for
example, to data points related to the same frequency.
Then each of the resulting differential data points is
squared and the sum of the squared data points is
15 provided. The sum of the squared data points is
referred to herein as the "squared error." The
interface class corresponding to the lowest of the
squared errors exhibits the greatest similarity, and is
selected as the most probable interface class being used
20 by the communication pathway.

It has been found that a preferred method of
determining the similarity includes determining a
normalized set of data points corresponding to the group
FFT information, and a corresponding set of data points
25 corresponding to the IC FFT information. Both data sets

are smoothed, for example with a Savitzky-Golay filter, and then normalized. The squared error is determined from the smoothed and normalized information.

A Savitzky-Golay filter can be considered a
5 weighted moving average. It replaces each data point, f_i with a linear combination g_i of itself and some number of nearby neighbors according to the following equation:

$$g_i = \sum_{n=-N_L}^{n=N_R} C_n f_{i+n}$$

10 In the equation, N_L is the number of data points used to the left of the filtered data point and N_R is the number to the right, or in the example given above, the number of data points used that are lesser in frequency and greater in frequency, respectively. Savitzky-Golay is a
15 method of computing the coefficients, c_n . Chapter 14 of *Numerical Recipes In C*, second edition, written by William Press, Saul Teukolsky, William Vetterling and Brian Flannery, published by the Press Syndicate of the University of Cambridge in 1992, has more information
20 about the Savitzky-Golay method. *Numerical Recipes In C*, is hereby incorporated by this reference.

The smoothing filter coefficients are computed via the Savitzky-Golay method, as described in *Numerical Recipes in C*. The coefficients are then used to smooth
25 the data sets corresponding to the group FFT information

and the IC FFT information. In one embodiment of the present invention, N_L and N_R were both equal to 128 and an order of 3 was used. The Savitzky-Golay method is preferably also applied to the interface class FFT information. Since the Savitzky-Golay method can widen main lobes and fill in nulls, the choice of coefficients used to smooth the data sets is preferably made to preserve the main lobe and the first null.

It should be noted at this point that the fourth moment of some interface classes is a function of the loop length. The measured fourth moment can be used to generate an estimate of the loop length. The loop length estimate can then be used to enhance the process of comparing spectral density taking the effects of loop length into consideration when determining the group FFT information.

The similarity between group signals and interface classes can be determined by comparing bit rate and encoding scheme information. The spectral density described above is one method of using these characteristics. Another method of determining bit rates uses a phase-lock-loop circuit ("PLL"). The PLL is applied against the incoming bit stream and indicates a lock when it identifies the bit rate. To do so, the PLL may need a broad dynamic range in order to meet the

wide range of bit rates characteristic of communication pathways, such as those communication pathways supporting telephony switches.

Yet another method of determining the bit rate
5 involves detecting zero crossings of the incoming bit stream. It should be noted the alternating signals that are characteristic of the communication pathway cross a zero (average) voltage level as they alternate between maximum and minimum voltage values. Zero (average)
10 crossing timing is an indicator of the bit rate, as well as the bit rate precision that is characteristic of a particular interface class.

When the corresponding measured voltage amplitudes are taken at the same discrete time, the resulting
15 correlation value (auto correlation or cross correlation) is referred to herein as a "zero lag correlation value." It should be noted that corresponding measured voltage amplitudes need not be taken at the same time. In some situations it may be
20 beneficial to have corresponding measured voltage amplitudes that are taken at different times. For example, a time lag of 125 micro seconds, 250 micro seconds or 500 micro seconds has been found useful in determining which known interface class is used on a
25 communication pathway. When the corresponding measured

voltage amplitudes are taken at different times, the resulting correlation value is referred to by the time lag, for example a "125 micro second lag correlation value." The value in applying a lag to the correlation
5 is to determine whether a signal exhibits any periodicity. Periodicity is another factor that may be used to distinguish an interface class. Some interface classes divide the signal into frame periods for conveying information, and may hence exhibit a periodic
10 signal that can be determined through the use of a non-zero lag correlation.

Throughout the disclosure so far, various measurements have been described. It should be noted additional measurements may be made to provide more
15 representative information. For example, it was stated the voltage amplitude of a signal is measured during a first time period and during a second time period. As is well known, two measurements often give less representative information than would, for example, ten
20 measurements. The number of time periods and the number of discrete times within a time period should be selected to suit the particular situation. For example, in most telephony networks, sampling the voltage amplitude of a signal during ten time periods of 800

microseconds each, at a rate of 10 mega hertz, will produce sufficiently representative arrays.

A device 100 for carrying out the methods described above is shown in Figures 3 and 4. The device 100 includes a first connector 103 having a first set of conductors, a conductor selection device 106 and a second connector 109, which may include British Naval Connectors ("BNCs"). The first connector 103 is capable of connecting to a communication pathway 112 and carrying signals from the communication pathway 112 via the conductors. For example, the first connector 103 may be an RJ-45 jack. The conductor selection device 106 is connected to the first connector 103 and the second connector 109. Preferably, the conductor selection device is capable of selecting between the conductors, and connecting some of the conductors to the second connector 109.

A computer 115 is connected to the second connector 109 and has software running thereon. An analog-digital converter 118 may be necessary for the computer 115 to interface with the second connector 109. In an embodiment of the present invention, the analog-digital converter 118 provides two channels of data acquisition with a maximum sampling rate of 10 million samples per second at 12 bit precision. A device driver for the

computer 115 is advisable to provide a high level interface between the computer and the analog-digital converter 118.

The software is capable of instructing the computer
5 115 to determine which of the conductors are active.
The software is also capable of instructing the computer
115 to compare the determined active conductors to
information corresponding to a known interface (step
22), and then to instruct the computer to send a signal
10 indicating whether the known interface is similar to the
determined active conductors (step 25).

In a preferred embodiment of the device 100, the
software is further capable of comparing a list of the
active conductors to an interface class list, the
15 interface class list identifying conductors used in
transmitting signals according to the interface class,
and if the list of the active conductors is similar to
the interface class list, then instructing the computer
115 to send a signal identifying the interface class.

20 The software is preferably capable of instructing
the computer 115 to determine which conductors are
carrying signals representing differentially driven data
corresponding to the same signal, and capable of
instructing the computer 115 to group the conductors
25 into conductor groups, wherein each conductor group

represents conductors carrying differentially driven data corresponding to the same signal.

In addition, the software is further capable of instructing the computer 115 to determine whether the
5 conductors in each conductor group are similar to sets of conductors used in transmitting signals according to an interface class. If the conductors in each group are similar to the sets of conductors, the software instructs the computer 115 to send a signal identifying
10 the interface class. In addition, the software is further capable of controlling and monitoring the operation of relay matrixes 121, 124, 125, 133 within the conductor selection device 106.

The device according to the present invention may
15 include an attenuator 121 connected between the first and second connectors 103,109 for attenuating a signal carried between the first and second connectors 103, 109. The attenuator 121 is used to attenuate a signal from the communication pathway 112 so that the signal is
20 within a range acceptable by other devices. The attenuator 121 may be a matrix of 8 double pole, single throw switches ("DPST") which can select a series resistance when used in conjunction with a 10 kilo ohm attenuation bypass resistor. Selection of an
25 appropriate series resistance will form a simple voltage

divider used to provide signal attenuation to extend the dynamic range of an analog-digital converter 118.

A shunt load device 124 may also be included to minimize a reflected signal by matching the interface class balanced impedance. As an example, a matrix of eight single pole, single throw ("SPST") switches can select a shunt load between two selected conductors. The shunt load device may provide seven discrete resistances plus a bypass. For example, the resistances may be 33 ohms, 51 ohms, 82 ohms, 120 ohms, 270 ohms, 470 ohms and 1,000 ohms.

A pin selection device 125 may also be included to select two individual conductors of the eight conductors of connector 103 for signal analysis. The pin selection device 125 may be a matrix of sixteen SPST switches.

The conductor selection device 106 may further include a power supply 127 for supplying power to the conductor selection device 106. An RS-232 interface module 130 may be supplied to control and monitor operation of a relay matrix board. A preferred relay matrix board has 64 DPST normally open, dry contact reed relays and provides all switching interfaces for the conductor selection device.

An AC/DC coupling device 133 having two 20 micro Farad capacitors is preferably included to protect the

conductor selection device 106 from excessive currents. A further protection circuit may also be included to shunt stored current in the capacitors before switching between conductors.

5 Four Zener diodes 136 may be provided to protect the input stage of the analog-digital converter 118. In one embodiment of the present invention, the Zener diodes 136 preferably provide a 10 volt shunt to ground across selected conductors.

10 Finally, a differential probe 139 may be provided. The differential probe 139 provides high common mode rejection ratio for signal analysis once pairs of conductors have been determined.

The present invention also includes a computer
15 readable storage medium 142. The storage medium 142 may be, for example, a computer disk such as a compact disk or floppy disk, read-only-memory or random-access memory. The storage medium 142 has encoded thereon computer readable instructions capable of instructing a
20 computer to carry out the method described above. In particular, the encoded instructions are capable of instructing a computer to analyze signals carried by conductors connected to a communication pathway to determine which of the conductors are active conductors.
25 The instructions are also capable of instructing the

computer 115 to compare the active conductors to
interface class information, and then determine whether
the interface class information is similar to the active
conductors. Finally, the instructions are capable of
5 instructing the computer 115 to provide a first
indication signal, the first indication signal being a
first type if the interface class information is similar
to the active conductor information, and the first
indication signal being a second type if the interface
10 class information is not similar to the active conductor
information.

A preferred storage medium 142 also has computer
readable instructions encoded thereon that are capable
of instructing the computer 115 to analyze signals
15 carried by conductors connected to a communication
pathway, to determine which of the conductors are active
conductors, and then group the active conductors into
groups of active conductors, each group of active
conductors having a pair of active conductors. The
20 encoded instructions are also capable of instructing the
computer 115 to compare group information to interface
class information, wherein the group information
includes information about the active conductors in each
group, and the interface class information includes
25 information about the pairing of conductors for a known

interface class. Finally, the encoded instructions are
capable of instructing the computer 115 to determine
whether the interface class information is similar to
the group information, and provide an indication signal
5 indicating whether the interface class information is
similar to the group information.

Although preferred embodiments of the present
invention have been described and illustrated herein,
the present invention is not limited to such preferred
10 embodiments. Since various changes could be made
without departing from the spirit and scope of the
invention, it is intended that the foregoing description
shall be interpreted as illustrative, and not
interpreted in a limiting sense. Furthermore, it is
15 intended that the present invention shall be limited
only by the following claims.

What is claimed is:

1. A method of providing an indication signal,
comprising:

5 providing a communication pathway carrying signals;
connecting the communication pathway to an
interface device, the interface device having conductors
for carrying the signals;

analyzing the signals carried by the conductors to
10 determine which of the conductors are active conductors;
providing active conductor information, wherein the
active conductor information includes a list of the
active conductors;

providing primary interface class information,
15 wherein the primary interface class information includes
information about the active conductors for a known
interface class;

determining whether the primary interface class
information is similar to the active conductor
20 information; and

providing a first indication signal, the first
indication signal being a first type if the information
about the active conductors for the interface class is
similar to the active conductor information, and the
25 first indication signal being a second type if the

information about the active conductors for the interface class is not similar to the active conductor information.

- 5 2. The method of claim 1, wherein analyzing the conductors to determine which of the conductors are active conductors includes selecting a conductor; analyzing the signal carried by the selected conductor to determine whether a voltage of the signal
10 carried by the selected conductor alternates; and determining the selected conductor is an active conductor if the voltage of the signal carried by the selected conductor alternates.

- 15 3. The method of claim 1, wherein the information about the active conductors for the interface class is similar to the active conductor information if the information about the active conductors for the interface class is among the active conductor
20 information.

4. The method of claim 1, wherein analyzing the conductors to determine active conductors includes determining which conductors are inactive, wherein
25 determining which conductors are inactive includes:

determining which conductors carry a signal having an alternating voltage;

determining an average amplitude voltage value for each of the conductors carrying a signal having an alternating voltage;

determining a reference amplitude voltage; and
determining inactive conductors, wherein the inactive conductors are those conductors corresponding to determined average amplitude voltage values that are less than the reference amplitude voltage.

5. The method of claim 4 wherein determining a reference amplitude voltage includes setting the reference amplitude voltage at one-half of the largest average amplitude voltage value.

6. The method of claim 4, wherein determining the average amplitude voltage value for one of the conductors carrying a signal having an alternating voltage includes:

measuring the voltage amplitude of the signal carried by the one of the conductors at a plurality of discrete times during a first time period to provide a first array of voltage amplitudes;

measuring the voltage amplitude of the signal
carried by the one of the active conductors at a
plurality of discrete times during a second time period
to provide a second array of voltage amplitude values;

5 selecting the maximum voltage amplitude from each
array; and

 determining the average of the maximum voltage
amplitudes to provide the average voltage amplitude
value.

10

7. A method of providing an indication signal
comprising:

 providing a communication pathway carrying signals;
 connecting the communication pathway to an

15 interface device, the interface device having conductors
for carrying the signals;

 analyzing the signals carried by the conductors to
determine which of the conductors are active conductors;

 providing active conductor information, wherein the
20 active conductor information includes a list of the
active conductors;

 grouping the active conductors into groups of
active conductors, each group of active conductors
having a pair of active conductors;

providing group information, wherein the group information includes information about the active conductors in each group;

providing primary interface class information,
5 wherein the primary interface class information includes information about the pairing of conductors for a known interface class;

determining whether the information about the pairing of conductors for the known interface class is
10 similar to the group information; and

providing a first indication signal, the first indication signal being a first type if the primary interface class information is similar to the group information, and the first indication signal being a
15 second type if the primary interface class information is not similar to the group information.

8. The method of claim 7, wherein grouping the active conductors into groups includes:

20 determining possible pairs of active conductors;
determining auto correlation values corresponding to each possible pair of active conductors;
setting a threshold value; and

eliminating one of the possible pairs of active conductors if the corresponding auto correlation value is less than the threshold value.

- 5 9. The method of claim 8, wherein determining the auto correlation value corresponding to each possible pair of active conductors includes:

10 selecting a possible pair of active conductors having a first active conductor and a second active conductor;

measuring a voltage amplitude of the signal carried by the first active conductor at a plurality of discrete times during a time period to provide a first array of voltage amplitudes corresponding to the first conductor;

15 squaring each measured amplitude in the first array corresponding to the first conductor and adding the squared measured amplitudes together to provide a first auto correlation value;

20 measuring a voltage amplitude of the signal carried by the second active conductor at the plurality of discrete times during the time period to provide a second array of voltage amplitudes corresponding to the second conductor;

squaring each measured amplitude in the second array and adding the squared measured amplitudes together to provide a second auto correlation value; and

determining the auto correlation value
5 corresponding to the selected possible pair of active conductors by determining the average of the first auto correlation value and the second auto correlation value.

10 10. The method of claim 8, wherein determining the auto correlation values corresponding to each possible pair of active conductors accounts for periodicity in signals carried by each possible pair of active conductors.

15 11. The method of claim 10, wherein determining the auto correlation values corresponding to each possible pair of active conductors includes:

selecting a possible pair of active conductors having a first active conductor and a second active conductor;

20 measuring a voltage amplitude of the signal carried by the first active conductor at a plurality of discrete times during a first time period to provide a first array of voltage amplitudes corresponding to the first conductor;

squaring each measured amplitude in the first array corresponding to the first conductor and adding the squared measured amplitudes together to provide a first auto correlation value;

5 measuring a voltage amplitude of the signal carried by the second active conductor at a plurality of discrete times during a second time period, different from the first time period, to provide a second array of voltage amplitudes corresponding to the second
10 conductor;

squaring each measured amplitude in the second array and adding the squared measured amplitudes together to provide a second auto correlation value; and

determining the auto correlation values
15 corresponding to the selected possible pair of active conductors by determining the average of the first auto correlation value and the second auto correlation value.

12. The method of claim 8, wherein the threshold value
20 is equal to a multiple of the lowest auto correlation value corresponding to one of the possible pairs of active conductors.

13. The method of claim 12, wherein the multiple is
25 four.

14. The method of claim 7, wherein grouping the active conductors into groups includes:

5 selecting a first active conductor and a second active conductor to provide a possible pair of active conductors;

determining a cross correlation value corresponding to the possible pair of active conductors;

setting a threshold value; and

eliminating the possible pair of active conductors

10 if the cross correlation value is less than the threshold value.

15. The method of claim 14, wherein the threshold value is equal to a fraction of an auto correlation value

15 corresponding to the possible pair of active conductors.

16. The method of claim 15, wherein the auto correlation value corresponding to the possible pair of active conductors is determined by:

20 measuring a voltage amplitude of the signal carried by the first active conductor at a plurality of discrete times during a first time period to provide a first array of voltage amplitudes;

squaring each measured amplitude in the first array
and adding the squared measured amplitudes together to
provide a first sum of squares value;

measuring a voltage amplitude of the signal carried
5 by the first active conductor at a plurality of discrete
times during a second time period to provide a second
array of voltage amplitudes;

squaring each measured amplitude in the second
array and adding the squared measured amplitudes
10 together to provide a second sum of squares value;

determining a first auto correlation value by
adding the first sum of squares value to the second sum
of squares value;

measuring a voltage amplitude of the signal carried
15 by the second active conductor at the plurality of
discrete times during the first time period to provide a
third array of voltage amplitudes;

squaring each measured amplitude in the third array
and adding the squared measured amplitudes together to
20 provide a third sum of squares value;

measuring a voltage amplitude of the signal carried
by the second active conductor at the plurality of
discrete times during the second time period to provide
a fourth array of voltage amplitude values;

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squaring each measured amplitude in the fourth array and adding the squared measured amplitudes together to provide a fourth sum of squares value;

determining a second auto correlation value by
5 adding the third sum of squares value to the fourth sum of squares value; and

determining the auto correlation value corresponding to the one of the possible pairs of active conductors by determining the average of the first auto
10 correlation value and the second auto correlation value.

17. The method of claim 15, wherein the auto correlation value corresponding to the possible pair of active conductors accounts for periodicity in signals
15 carried by the possible pair of active conductors.

18. The method of claim 17, wherein the auto correlation value corresponding to the possible pair of active conductors is determined by:
20 measuring a voltage amplitude of the signal carried by the first active conductor at a plurality of discrete times during a first time period to provide a first array of voltage amplitudes;

squaring each measured amplitude in the first array
and adding the squared measured amplitudes together to
provide a first sum of squares value;

measuring a voltage amplitude of the signal carried
5 by the first active conductor at a plurality of discrete
times during a second time period to provide a second
array of voltage amplitudes;

squaring each measured amplitude in the second
array and adding the squared measured amplitudes
10 together to provide a second sum of squares value;

determining a first auto correlation value by
adding the first sum of squares value to the second sum
of squares value;

measuring a voltage amplitude of the signal carried
15 by the second active conductor at a plurality of
discrete times during a third time period, different
from the first time period, to provide a third array of
voltage amplitudes;

squaring each measured amplitude in the third array
20 and adding the squared measured amplitudes together to
provide a third sum of squares value;

measuring a voltage amplitude of the signal carried
by the second active conductor at a plurality of
discrete times during a fourth time period, different

from the second time period, to provide a fourth array
of voltage amplitude values;

squaring each measured amplitude in the fourth
array and adding the squared measured amplitudes

5 together to provide a fourth sum of squares value;

determining a second auto correlation value by
adding the third sum of squares value to the fourth sum
of squares value; and

determining the auto correlation value
10 corresponding to the one of the possible pairs of active
conductors by determining the average of the first auto
correlation value and the second auto correlation value.

19. The method of claim 14, wherein the fraction is
15 one-half.

20. The method of claim 14, wherein determining the
cross correlation value includes:

measuring a voltage amplitude of the signal carried
20 by the first active conductor at a plurality of discrete
times during a first time period to provide a first
array of voltage amplitudes;

measuring a voltage amplitude of the signal carried
by the first active conductor at a plurality of discrete

times during a second time period to provide a second array of voltage amplitudes;

measuring a voltage amplitude of the signal carried by the second active conductor at the plurality of
5 discrete times during the first time period to provide a third array of voltage values;

measuring a voltage amplitude of the signal carried by the second active conductor at the plurality of discrete times during the second time period to provide
10 a fourth array of voltage values; and

multiplying voltage values in the first array with corresponding voltage values in the third array, and multiplying voltage values in the second array with corresponding voltage values in the fourth array, and
15 adding the products together to provide the cross correlation value.

21. The method of claim 14, wherein determining the cross correlation value accounts for periodicity in
20 signals carried by the possible pair of active conductors.

22. The method of claim 21, wherein determining the cross correlation value includes:

measuring a voltage amplitude of the signal carried by the first active conductor at a plurality of discrete times during a first time period to provide a first array of voltage amplitudes;

5 measuring a voltage amplitude of the signal carried by the first active conductor at a plurality of discrete times during a second time period to provide a second array of voltage amplitudes;

10 measuring a voltage amplitude of the signal carried by the second active conductor at a plurality of discrete times during a third time period, different from the first time period, to provide a third array of voltage values;

15 measuring a voltage amplitude of the signal carried by the second active conductor at a plurality of discrete times during a fourth time period, different from the second time period, to provide a fourth array of voltage values; and

20 multiplying voltage values in the first array with corresponding voltage values in the third array, and multiplying voltage values in the second array with corresponding voltage values in the fourth array, and adding the products together to provide the cross correlation value.

23. The method of claim 7, wherein the primary interface class information is similar to the group information if the primary interface class information is among the group information.

5

24. A method of providing an indication signal, comprising:

providing a communication pathway carrying signals;

connecting the communication pathway to an

10 interface device, the interface device having conductors for carrying the signals;

analyzing the signals carried by the conductors to determine which of the conductors are active conductors;

15 grouping the active conductors into groups of active conductors, each group of active conductors having a pair of active conductors;

receiving a first group signal, the first group signal including the signals carried by a first group of active conductors;

20 determining a fourth moment of the first group signal;

providing interface class information, wherein the interface class information includes information about a fourth moment of a pair signal, the pair signal being a

signal corresponding to conductors corresponding to the first group of active conductors;

determining whether the fourth moment of the pair signal is similar to the fourth moment of the first

5 group signal; and

providing an indication signal, the indication signal being a first type if the information about the fourth moment of the pair signal is similar to the fourth moment of the first group signal, and the indication signal being a second type if the information about the fourth moment of the pair signal is not similar to the fourth moment of the first group signal.

25. The method of claim 24, wherein the fourth moment of the pair signal is similar to the fourth moment of the first group signal if the fourth moment of the pair signal is within about 35% of the fourth moment of the first group signal.

26. A method of providing an indication signal, comprising:

providing a communication pathway carrying signals; connecting the communication pathway to an interface device, the interface device having conductors for carrying the signals;

analyzing the signals carried by the conductors to
determine which of the conductors are active conductors;

grouping the active conductors into groups of
active conductors, each group of active conductors

5 having a pair of active conductors;

receiving a first indication signal corresponding
to a first interface class indicating the first
interface class is possibly used on the communication
pathway;

10 receiving a second indication signal corresponding
to a second interface class indicating the second
interface class is possibly used on the communication
pathway;

providing interface class information;

15 providing first group signal information relating
to signals carried by a first one of the groups of
active conductors;

determining a first difference between the first
interface class information and the first group signal
20 information;

determining a second difference between the second
interface class information and the first group signal
information;

comparing the first difference with the second
25 difference; and

providing an indication signal, the indication
signal being a first type if the first difference is
less than the second difference, and being a second type
if the second difference is less than the first
5 difference.

27. The method of claim 26, wherein the interface class
information includes information related to a spectral
density of a signal characteristic of the first
10 interface class and includes information related to a
spectral density of a signal characteristic of the
second interface class.

28. The method of claim 27, wherein the information
15 related to the spectral density of a signal
characteristic of the first interface class includes a
bit rate, and the information related to the spectral
density of a signal characteristic of the second
interface class includes a bit rate.

29. The method of claim 26, wherein the first group
20 signal information includes a bit rate.

30. The method of claim 29, wherein the bit rate is
25 determined using a phase lock loop circuit.

corresponding to the first interface class that have
been smoothed by a Savitzky-Golay filter.

35. The method of claim 33, wherein the first group
5 signal FFT information includes data points generated by
the fast fourier transform of the first group signal
that have been smoothed by a Savitzky-Golay filter.

36. The method of claim 33, wherein determining the
10 first difference includes determining the squared error
between the first interface class FFT information and
the first group signal FFT information.

37. A discovery device, comprising:
15 a switch interface device having a first connector
including a first set of conductors, a conductor
selection device and a second connector, the first
connector being capable of connecting to a communication
pathway and carrying signals from the communication
20 pathway via the conductors, and the conductor selection
device being connected to the first connector and the
second connector; and

a computer connected to the second connector and
having software running thereon, the software being
25 capable of instructing the computer to determine which

of the conductors are active, the active conductors being those that carry the signals.

38. The device of claim 37, wherein the software is
5 further capable of instructing a computer to compare a
list of the active conductors to an interface class
list, the interface class list identifying conductors
used in transmitting signals according to the interface
class, and if the list of the active conductors is
10 similar to the interface class list, then instructing
the computer to send a signal identifying the interface
class.

39. The device of claim 37, wherein the software is
15 further capable of instructing the computer to determine
which conductors are carrying signals representing
differentially driven data corresponding to the same
signal, and capable of instructing the computer to group
the conductors into conductor groups, each conductor
20 group representing conductors carrying differentially
driven data corresponding to the same signal.

40. The device of claim 39, wherein the software is
further capable of instructing the computer to determine
25 whether the conductors in each conductor group are

similar to sets of conductors used in transmitting
signals according to an interface class, and if the
conductors in each conductor group are similar to the
sets of conductors, then instructing the computer to
5 send a signal identifying the interface class.

41. The device of claim 37, wherein the conductor
selection device is capable of selecting between the
conductors, and connecting some of the conductors to the
10 second connector.

42. The device of claim 37, further comprising an
attenuator connected between the first and second
connectors for attenuating a signal carried between the
15 first and second connectors.

43. The device of claim 42, wherein the conductor
selector is capable of selecting two conductors, and the
device further comprises a shunt load apparatus disposed
20 between the two conductors.

44. A computer readable storage medium having encoded
thereon computer readable instructions capable of
instructing a computer to:

analyze signals carried by conductors connected to
a communication pathway to determine which of the
conductors are active conductors;

determine active conductor information, wherein the
5 active conductor information includes a list of the
active conductors;

compare the active conductor information to
interface class information, wherein the interface class
information includes information about the active
10 conductors for a known interface class;

determine whether the interface class information
is similar to the active conductor information; and

provide an indication signal, the indication signal
being a first type if the interface class information is
15 similar to the active conductor information, and the
indication signal being a second type if the interface
class information is not similar to the active conductor
information.

20 45. A computer readable storage medium having encoded
thereon computer readable instructions capable of
instructing a computer to:

analyze signals carried by conductors connected to
a communication pathway, to determine which of the
25 conductors are active conductors;

group the active conductors into groups of active conductors, each group of active conductors having a pair of active conductors;

compare group information to interface class
5 information, wherein the group information includes information about the active conductors in each group, and the interface class information includes information about the grouping of conductors for a known interface class;

10 determine whether the interface class information is similar to the group information; and

provide a first indication signal, the first indication signal being a first type if the interface class information is similar to the group information,
15 and the first indication signal being a second type if the interface class information is not similar to the group information.

ABSTRACT

Methods and devices of determining the interface class used on a communication pathway are disclosed.

5 The method compares information derived from the communication pathway to information about known interface classes to determine whether the derived information is similar to the information corresponding to the known interface classes.

10 Devices according to the present invention include hardware and computer readable storage mediums having encoded instructions for carrying out the method.

BFLODOCS:398831_1 (8JQN01)

Figure 1. The effect of the concentration of the *Agrobacterium* suspension on the transformation efficiency of *Agrobacterium* strains. The *Agrobacterium* strains were grown in YEA medium at 28°C for 24 h. The cell concentration was adjusted to 10⁸ cells/ml. The cells were then mixed with the plant tissue and the transformation efficiency was determined. The results are shown as the mean ± SD of three independent experiments. The transformation efficiency was significantly different from the control (p < 0.05) by the Student's *t*-test.

PROVIDE A COMMUNICATION PATHWAY CARRYING SIGNALS AND CONNECT THE COMMUNICATION PATHWAY TO AN INTERFACE DEVICE HAVING CONDUCTORS.

ANALYZE SIGNALS CARRIED BY THE CONDUCTORS TO DETERMINE WHICH CONDUCTORS ARE ACTIVE CONDUCTORS.

PROVIDE ACTIVE CONDUCTOR INFORMATION.

PROVIDE INTERFACE CLASS INFORMATION.

DETERMINE WHETHER THE INTERFACE CLASS INFORMATION IS SIMILAR TO THE ACTIVE CONDUCTOR INFORMATION.

PROVIDE A FIRST TYPE OF INDICATION SIGNAL IF SIMILARITY IS DETERMINED, AND PROVIDE A SECOND TYPE OF INDICATION SIGNAL IF SIMILARITY IS LACKING.

FIGURE 1

PROVIDE A COMMUNICATION PATHWAY CARRYING SIGNALS AND CONNECT THE COMMUNICATION PATHWAY TO AN INTERFACE DEVICE HAVING CONDUCTORS.

210

ANALYZE THE SIGNALS CARRIED BY THE CONDUCTORS TO DETERMINE WHICH CONDUCTORS ARE ACTIVE CONDUCTORS.

213

GROUP THE ACTIVE CONDUCTORS AND PROVIDE GROUP INFORMATION.

228

PROVIDE INTERFACE CLASS INFORMATION.

219

COMPARE THE GROUP INFORMATION WITH THE INTERFACE CLASS INFORMATION TO DETERMINE WHETHER THE GROUP INFORMATION IS SIMILAR TO THE INTERFACE CLASS INFORMATION.

234

PROVIDE A FIRST TYPE OF INDICATION SIGNAL IF SIMILARITY IS DETERMINED, AND PROVIDE A SECOND TYPE OF INDICATION SIGNAL IF SIMILARITY IS LACKING.

225

FIGURE 2

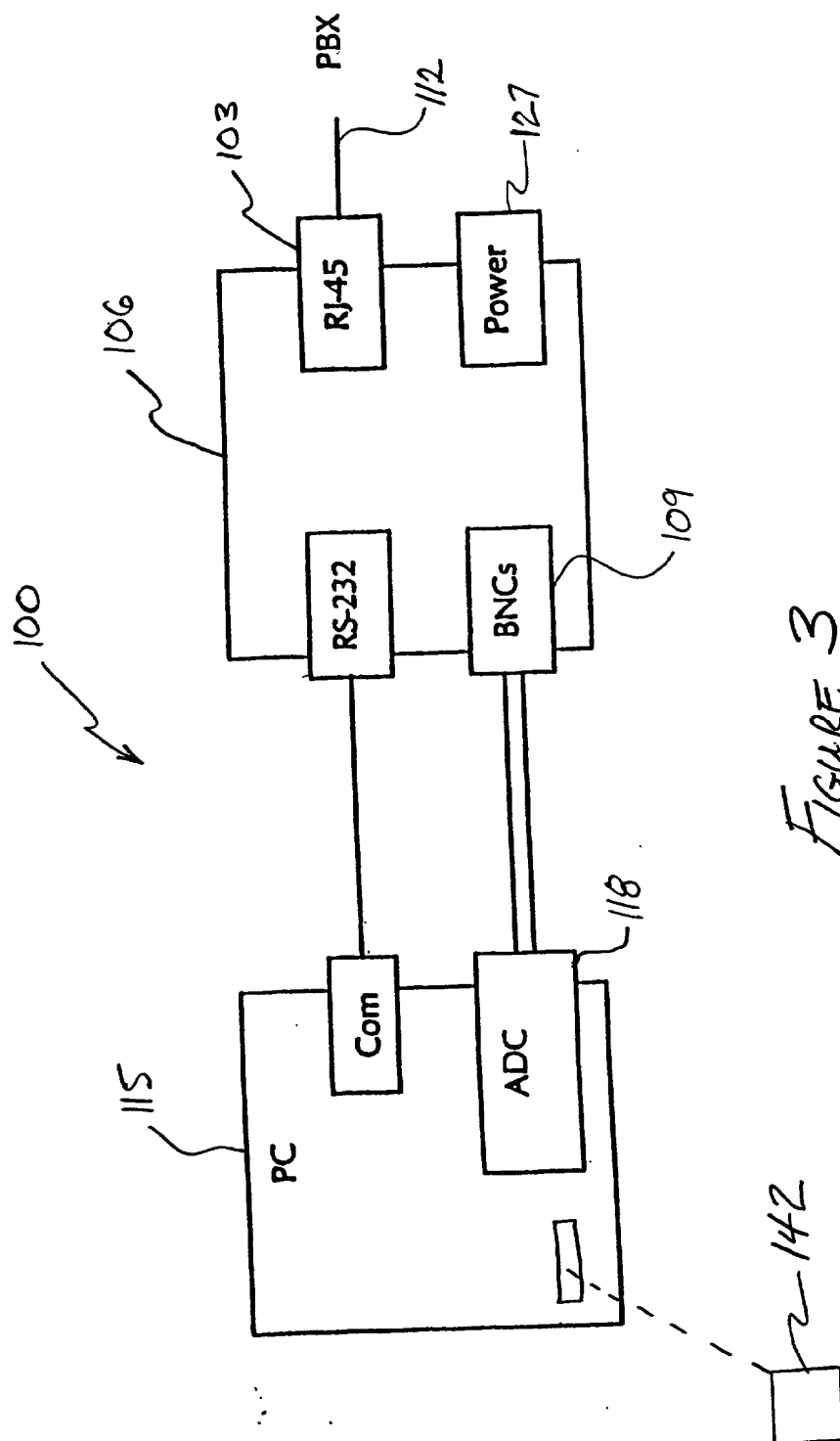


FIGURE 3

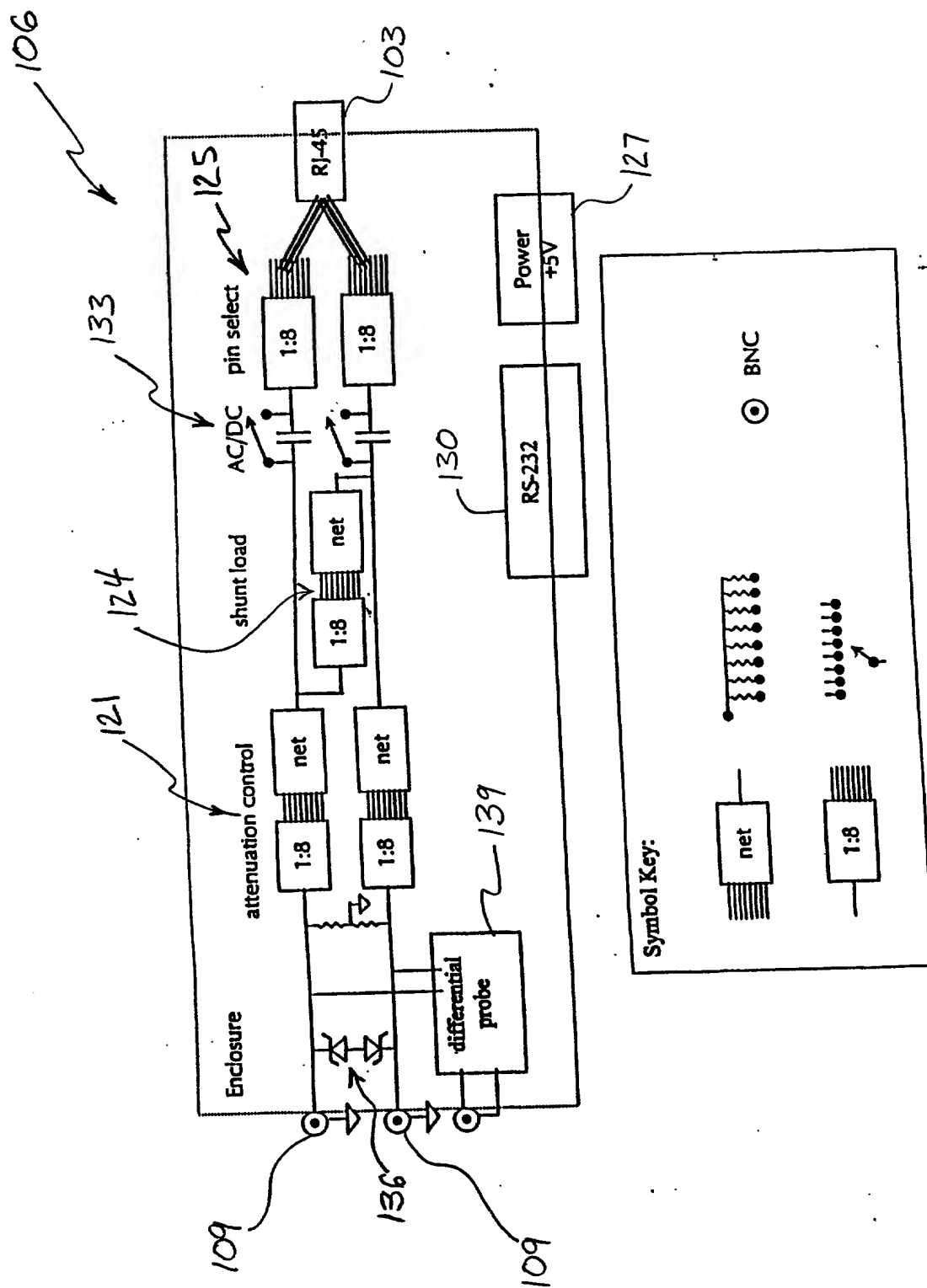


FIGURE 4

**DECLARATION FOR UTILITY OR
DESIGN
PATENT APPLICATION
(37 CFR 1.63)**

Attorney Docket Number 11983.0046

First Named Inventor Steven G. DeNies

COMPLETE IF KNOWN

Application Number

Filing Date June 14, 2000

Group Art Unit

Examiner Name

☒ Declaration Submitted with Initial Filing **OR** ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16(e)) required)

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Interface Class Discovery Method and Device

the specification of which
☒ is attached hereto
OR

Interface Class Discovery Method and Device

was filed on (MM/DD/YYYY) as United States Application Number or PCT International
Application Number and was amended on (MM/DD/YYYY) (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application (Numbers)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES NO	
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	<input type="checkbox"/> Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.
60/139,112	06/14/1999	

Jun-14-00 01:40pm From:HODGSON RUSS

T-594 P 05/08 F-319

DECLARATION - Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number**Parent Filing Date (MM/DD/YYYY)****Parent Patent Number (if applicable)**

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

☐ Customer Number

OR

☒ Registered practitioner's name/registration number listed below

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Name	Registration Number	Name	Registration Number
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☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor:☐ A petition has been filed for this unsigned inventor

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Inventor's Signature

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☐ Additional inventors are being named on the one supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto

Jun-14-00 01:40pm From:MODGSON RUSS

T-594 P.06/08 F-318

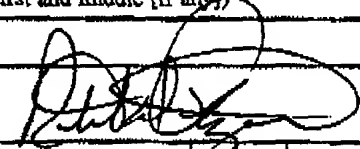
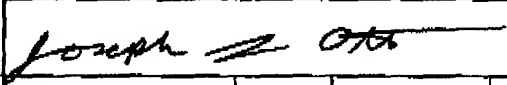
Please type a plus sign inside this box ☐

PTO/SB/02A (3/97)

Approved for use through 09/30/00, OMB 0651-0032

DECLARATION

ADDITIONAL INVENTOR(S)
Supplemental Sheet
Page 3 of 3

Name of Additional Joint Inventor, if any:		<input type="checkbox"/> A petition has been filed for this unsigned inventor					
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Inventor's Signature						Date	6/14/2000
Residence: City	Williamsville	State	New York	Country	U.S.A.	Citizenship	U.S.A.
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City	Williamsville	State	New York	ZIP	14221	Country	U.S.A.
Name of Additional Joint Inventor, if any:		<input type="checkbox"/> A petition has been filed for this unsigned inventor					
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Inventor's Signature						Date	6/14/2000
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Post Office Address							
City	Depew	State	New York	ZIP	14043	Country	U.S.A.
Name of Additional Joint Inventor, if any:		<input type="checkbox"/> A petition has been filed for this unsigned inventor					
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